EMERGENCY EVACUATION MANAGEMENT METHOD, SYSTEM, AND PROGRAM PRODUCT

REFERENCE TO PRIOR APPLICATIONS

[0001] The current application is a continuation-in-part of U.S. Application No. 10/764,258, filed on January 23, 2004, and claims the benefit of U.S. Provisional Application Nos. 60/449,373, filed on February 24, 2003, 60/497,646, filed on August 25, 2003, and Attorney Docket No. DION-0002, filed on February 4, 2004, each of which is hereby incorporated herein by reference; U.S. Application No. 10/764,258 claims the benefit of U.S. Provisional Application Nos. 60/442,811, filed on January 24, 2003, 60/449,373, filed on February 24, 2003, and 60/497,646, filed on August 25, 2003.

BACKGROUND OF THE INVENTION

1. TECHNICAL FIELD

[0002] The invention relates generally to managing occupants of a physical area, such as one or more buildings, and more specifically, to a method, system, and program product that associate occupant information to information regarding a physical area. The physical area information can be used to access the associated occupant information and provide information to occupants.

[0003] The invention further relates generally to responding to an emergency event that affects the physical area, and more specifically, to a method, system, and program product that use a predefined response plan to communicate with occupants and/or responders of the physical area during an emergency event.

2. RELATED ART

[0004]   For most companies, employees continue to be assigned a desk and/or office within one or more buildings. During the work day, most employees are primarily located at their assigned desk/office. While at work, an employee typically uses a desktop computer, telephone, and the like in the office to communicate with co-workers and perform his/her work. Increasingly, companies are providing employees with personal communication devices such as personal digital assistants (PDAs), pagers, mobile telephones, and the like. These devices enable an employee to communicate with others in the company, check e-mail, check voice mail, etc., when the employee is away from his/her office. Further, employees may purchase one or more personal communication devices that family members and friends typically use to contact the employee. As a result, while at work, there are often several forms of communication that can be used to contact a particular employee.

[0005]   For a new employee, time may be unnecessarily spent determining the location of various rooms such as a bathroom, conference room, etc. Additionally, an employee may need to determine an office location of a co-worker, or contact information for the co-worker such as an extension. Further, in public buildings such as an airport, a mall, or the like, a user may desire directions to a particular gate, a desired store, etc. While maps are typically provided periodically throughout these buildings, occupants frequently find that they are not convenient or easy to read.

[0006]   As a result, a need exists for a solution that provides information about occupants of a physical area to another occupant of the physical area in an efficient manner that can be based on the location of the occupant. A further need exists for providing custom directions to an occupant of a building or other structure based on the occupant's current location and a specified

destination location. To this extent, a need exists for a solution that generates and/or uses a hierarchical representation of a physical area to provide directions and/or occupant information to an occupant using any type of communication device, and in particular, a wireless communication device such as a PDA or a mobile telephone.

[0007] Further, emergency responders such as police, fire, and emergency medical technicians (EMTs), and the like are increasingly being equipped with personal communication devices that allow the responders to maintain contact with each other while responding to an emergency situation. This communication equipment has enabled the responders to cooperate better and respond to the emergency in a more efficient manner. However, to date, little or no communication occurs between the emergency responders and occupants of a building in which the emergency (e.g., a fire) is occurring. As a result, responders must spend a great deal of time and effort in determining whether any occupants remain in a building, the likely location of the occupants, and whether they are safe or in danger. All too often, responders enter an unsafe structure under a mistaken belief that an occupant remains inside, thereby exposing the responder to an unnecessary risk.

[0008] As a result, a further need exists for a solution that enables responders and occupants to communicate during an emergency event. In particular, a need exists for a method, system, and program product that obtains information for occupants of a physical area such as a building, and assigns the information to a location in the physical area where the occupant is or is most likely to be located. In this manner, emergency responders can use the information to contact and/or attempt to contact the occupant as well as determine a region within the physical area in which to search for the occupant.

SUMMARY OF THE INVENTION

[0009] The invention provides a solution for managing occupants of a physical area. Specifically, under the present invention, occupant information is associated with information about the physical area, and is used to obtain information about and provide information to occupants of the physical area. In one embodiment, a hierarchical representation of the physical area is obtained, and occupant information is associated with the hierarchical representation. In particular, a node that includes occupant information is associated with a node that represents a portion of the physical area in which the occupant is or is likely to be located. The hierarchical representation can be used in various applications. For example, each area node can include directions to exit points for a corresponding parent area. The directions can be used to construct directions for an occupant from a start location to a destination location. Further, contact information for locations and/or occupants can be included to enable various options for contacting an occupant to be readily obtained. In one embodiment, the contact information is used by emergency responders to obtain a status for one or more occupants, and/or allow an emergency responder to communicate with an occupant. The hierarchical representation can be updated dynamically, e.g., based on detected movement of occupants, or can be more static, e.g., based on office locations of occupants. In either case, the invention provides an improved solution for managing occupants of a physical area.

[0010] The invention can further comprise a solution for responding to an emergency event that affects the physical area. Specifically, under the present invention, a response plan can be planned for one or more types of emergency events (e.g., personal injury, fire, earthquake, etc.). The response plan can include one or more response operations that are each associated with a responder, occupant, and/or area for the physical area. Each response operation can be

implemented when the emergency event is identified to improve the response to the emergency event.

[0011]   A first aspect of the invention provides a method of managing occupants of a building during an emergency event, the method comprising: obtaining building information for a plurality of areas of the building; associating occupant information for an occupant located at one of the plurality of areas of the building with the corresponding building information; contacting the occupant using the occupant information during the emergency event; and obtaining a status of the occupant.

[0012]   A second aspect of the invention provides a method of managing occupants of a physical area, the method comprising: obtaining a plan for the physical area; generating a hierarchical representation of the physical area based on the plan, wherein the hierarchical representation includes a plurality of area nodes; obtaining occupant information for an occupant of the physical area; and associating the occupant information with an area node in the hierarchical representation.

[0013]   A third aspect of the invention provides a system for managing occupants of a physical area, the system comprising: means for obtaining a plan for the physical area; means for generating a hierarchical representation of the physical area based on the plan; means for obtaining occupant information for an occupant of the physical area; and means for associating the occupant information with an area node in the hierarchical representation.

[0014]   A fourth aspect of the invention provides a computer program product comprising a computer useable medium having computer readable program code embodied therein for managing occupants of a physical area, the program product comprising: program code configured to obtain a plan for the physical area; program code configured to generate a

hierarchical representation of the physical area based on the plan; program code configured to obtain occupant information for an occupant of the physical area; and program code configured to associate the occupant information with an area node in the hierarchical representation.

[0015] A fifth aspect of the invention provides a method of managing occupants of a physical area during an emergency event, the method comprising: identifying the emergency event; and activating a response plan based on the identified emergency event, wherein the activating step includes initiating at least one response operation for the response plan; selecting an occupant of the physical area based on a location of the emergency event; and providing instructions to the occupant based on the emergency event.

[0016] A sixth aspect of the invention provides a system for evacuating an occupant of a physical area during an emergency event, the system comprising: means for identifying the emergency event; means for automatically informing the occupant of the emergency event; means for obtaining a location of the occupant; means for obtaining an evacuation status of the occupant; and means for providing instructions to the occupant based on at least one of the emergency event, the location, and the evacuation status.

[0017] A seventh aspect of the invention provides a computer program product comprising a computer useable medium having computer readable program code embodied therein for responding to an emergency event, the program product comprising: program code configured to identify the emergency event; program code configured to activate a response plan based on the identified emergency event; and program code configured to perform a response operation based on the response plan, wherein the response operation includes: program code configured to obtain a status and a location of an occupant; and program code configured to provide instructions to the occupant.

[0018]   The illustrative aspects of the present invention are designed to solve the problems

herein described and other problems not discussed, which are discoverable by a skilled artisan.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]   These and other features of this invention will be more readily understood from the

following detailed description of the various aspects of the invention taken in conjunction with

the accompanying drawings in which:

[0020]   FIG. 1 shows an illustrative hierarchical representation of a building;

[0021]   FIG. 2 shows illustrative method steps for generating a hierarchical representation of a

building;

[0022]   FIG. 3 shows an illustrative system for managing occupants of a physical area;

[0023]   FIG. 4 shows illustrative method steps for obtaining a status of an occupant during an

emergency event;

[0024]   FIG. 5 shows alternative method steps for generating a hierarchical representation of a

building;

[0025]   FIG. 6 shows an illustrative hierarchical representation of a city;

[0026]   FIG. 7 shows an illustrative data relationship diagram for a response plan;

[0027]   FIG. 8 shows an illustrative method of responding to a chemical spill;

[0028]   FIGS. 9A-I show illustrative occupant interfaces according to one embodiment of the

invention; and

[0029]   FIGS. 10A-C show illustrative responder interfaces according to one embodiment of the

invention.

[0030] It is noted that the drawings of the invention are not to scale. The drawings are intended to depict only typical aspects of the invention, and therefore should not be considered as limiting the scope of the invention. In the drawings, like numbering represents like elements between the drawings.

DETAILED DESCRIPTION OF THE INVENTION

[0031] For convenience purposes only, the following outline is used in the description:

I. HIERARCHICAL REPRESENTATION

II. OVERVIEW OF AN ILLUSTRATIVE SYSTEM

III. APPLICATIONS

      A. DIRECTIONS AND CONTACT INFORMATION

      B. EMERGENCY RESPONSE

IV. PREDEFINED RESPONSE PLAN

V. SAMPLE USER INTERFACES

VI. ALTERNATIVES

I. HIERARCHICAL REPRESENTATION

[0032] As indicated above, the invention provides a solution for managing occupants of a physical area. Specifically, under the present invention, occupant information is associated with information about the physical area, and is used to obtain information about and provide information to occupants of the physical area. In one embodiment, a hierarchical representation of the physical area is obtained, and occupant information is associated with the hierarchical representation. In particular, a node that includes occupant information is associated with a node

that represents a portion of the physical area in which the occupant is or is likely to be located. The hierarchical representation can be used in various applications. For example, each area node can include directions to exit points for a corresponding parent area. The directions can be used to construct directions for an occupant from a start location to a destination location within the physical area. Further, contact information for locations and/or occupants can be included to enable various options for contacting an occupant to be readily obtained. In one embodiment, the contact information is used by emergency responders to obtain a status for one or more occupants, and/or allow an emergency responder to communicate with an occupant. The hierarchical representation can be updated dynamically, e.g., based on detected movement of occupants, or can be more static, e.g., based on office locations of occupants. In either case, the invention provides an improved solution for managing occupants of a physical area.

[0033] The following discussion of various aspects of the invention uses one application in which the physical area comprises a building, and more particularly an office building or publicly accessible building. However, it is understood that the teachings of the invention are not limited to this type of application. In particular, the teachings allow the system to be readily scaled into larger applications or smaller applications. To this extent, while the following discussion focuses on a building, it is understood that the teachings apply to any physical area, including other structures (e.g., a stadium or an airport), multiple buildings (e.g., a business park or a city block), a portion of a building, an apartment building, a house, a town or city, etc. Further, while the discussion uses a building plan as an illustrative plan for a physical area, it is understood that this could comprise any type of plan, including a map, a blueprint, etc. Still further, as will be made clear by the discussion below, "occupant" is used to refer to an individual that is, or may be, present within the physical area.

[0034]   As noted previously, one aspect of the invention provides for the generation of information about a physical area such as a building. In one embodiment, a hierarchical representation of the building is generated. In particular, the building can be subdivided in a hierarchical manner into increasingly smaller units of physical area. Each unit of physical area can be represented by an area node in the hierarchical representation, and the area node can include information about the physical area. Turning to the drawings, FIG. 1 shows an illustrative hierarchical representation 2 of a building. Hierarchical representation 2 is shown including a building node H1 for the building as a top level node. However, as discussed above, the physical area could be larger or smaller than a building. To this extent, hierarchical representation 2 could comprise a portion of a larger hierarchical representation. For example, building node H1 could be the child node of a city block node H8. In this manner, hierarchical representation 2 provides an efficient manner for increasing and/or decreasing the scale of the physical area. However, it is understood that hierarchical representation 2 is only illustrative of the various types of data structures that could be used to efficiently store and access information about a physical area. To this extent, the invention is not limited to use of hierarchical representation 2.

[0035]   Continuing with hierarchical representation 2, an area node such as building node H1 can have one or more child area nodes that each correspond to smaller areas included within the larger area. To this extent, for one or more floors of a building, a floor node H2-H3 can be added as a child of building node H1. Similarly, each floor node H2-H3, can have one or more floor area nodes H4-H5 as a child node that each correspond to unique physical areas of the corresponding floor. A floor area could comprise, for example, one or more rooms that are formed by a fixed wall. Consequently, a hall, a reception area, an office, a bathroom, etc., each

could have a floor area node H4-H5 in hierarchical representation 2. When the building comprises an office building, floor area nodes H4-H5 could each represent an area of the corresponding floor that is occupied by a different company. In any event, a floor area may be further sub-divided into rooms, cubicles formed by temporary walls, areas of a room, or the like. As a result, one or more floor area nodes H4-H5 could also have one or more sub-area nodes H6-H7 as a child. It is understood that hierarchical representation 2 is only illustrative. In particular, alternative hierarchical representations may include additional or fewer levels and nodes that subdivide the building using any solution.

[0036]   FIG. 2 shows an illustrative method for generating the hierarchical representation 2 shown in FIG. 1. In step G1, a building plan 4 (FIG. 1) is obtained. Building plan 4 could comprise a physical copy such as a printed plan, blueprint, etc., or comprise an electronic copy stored on a computer useable medium such as one or more computer-aided design (CAD) drawings, graphic files, etc. In either case, the obtaining step could comprise generating building plan 4, accessing an existing building plan 4, and/or converting building plan 4 from one form (physical copy) into a more suitable form (electronic copy). In any event, building plan 4 will include information on each floor of the building, such as its shape and dimensions, the location of walls, exits, etc.

[0037]   In step G2, hierarchical representation 2 (FIG. 1) of the building is generated using building plan 4 (FIG. 1). In particular, each unique floor in the building can be identified in building plan 4, and a corresponding floor node H2-H3 (FIG. 1) can be created and added to hierarchical representation 2. Similarly, areas and/or rooms on a floor, cubicles in a room, and the like can be identified in building plan 4 and added to hierarchical representation 2 in the appropriate locations. Floors, areas, sub-areas and the like can be identified manually,

automatically, or some combination thereof. For example, a user could refer to a physical

building plan 4, and generate hierarchical representation 2. Alternatively, a user could outline an

area in an electronic building plan 4 and define a corresponding floor area node H4-H5 or sub-

area node H6-H7. Further, a computer program product can be used to identify walls, exit

points, etc. in an electronic building plan 4 and automatically generate some or all of hierarchical

representation 2.

[0038]   As shown in FIG. 1, when building plan 4 is in an electronic format, one or more area

nodes H1-H7 can be associated with its corresponding portion of building plan 4. For example,

each floor node H2-H3 could be linked to the portion of building plan 4 that includes the entire

floor, while floor area node H5 may be linked to a particular area of the floor corresponding to

floor node H2. By linking one or more area nodes H1-H7 to building plan 4, the portion of

building plan 4 that corresponds to a selected area node H1-H7 can be readily displayed to a user

in a zoomed in and/or highlighted fashion. Further, a user could view building plan 4 and be

provided a corresponding area node H1-H7 after selecting a location in building plan 4.

[0039]   Hierarchical representation 2 is also shown including user nodes U1-U5 that are

associated with one or more area nodes H1-H7. Each user node U1-U5 can include user

information for a corresponding user. In particular, user nodes U1-U3 can each comprise

occupant information U1-U3 for a building occupant. Returning to FIG. 2, in step G3, occupant

information U1-U3 for one or more building occupants can be obtained. Occupant information

U1-U3 can be manually entered, automatically retrieved from an existing database or the like, or

some combination thereof. For example, occupant information U1-U3 can be provided by the

corresponding occupant of the building. Alternatively, occupant information U1-U3 can be

imported from a human resources database or the like. Still further, occupant information U1-U3

can be dynamically obtained by communicating with a wireless device or the like that is unique to a particular occupant.

[0040] In any event, returning to FIG. 2, in step G4 a location is obtained for each occupant of the building. In one embodiment, the location can be based on the most likely location of an occupant within the building, for example, the location of an occupant's office. Alternatively, the location can be obtained and updated dynamically by communicating with, for example, a wireless device carried by the occupant as he/she moves throughout the building. Still further, a combination of the two could be used. In the latter case, a first location for an occupant can be based on his/her office and, when the occupant is not in the office, a second location can be based on the current location of the occupant. In this case, occupant information U1-U3 (FIG. 1) could include a status that indicates whether or not the occupant is present at the location. It is understood that additional status information can also be included in occupant information U1-U3. For example, any health problems that the occupant may have could be included as status information in occupant information U1-U3.

[0041] Regardless, in step G5, occupant information U1-U3 is associated with hierarchical representation 2 (FIG. 1). In particular, as shown in FIG. 1, occupant information U1-U3 can be associated with an area node H1-H7 that corresponds to the location that was obtained for the occupant. For example, occupant information U1 can be associated with sub-area node H6 that corresponds to the location of the occupant's desk, and occupant information U2 can be associated with a sub-area node H7 that corresponds to a current location of the occupant.

[0042] Hierarchical representation 2 can also be generated dynamically as each user creates his/her user node U1-U5, and associates it with a physical location. For example, building plan 4 may not be available and/or registration may be performed in an unorganized manner by multiple

users. In any event, FIG. 5 shows an alternative method for generating hierarchical representation 2 (FIG. 1). In step A1, a user can enter his/her user information U1-U5 (FIG. 1) by using, for example, his/her personal device. In step A2, the user can enter location information for his/her corresponding location, e.g., his/her office. In one embodiment, the user answers a series of questions and/or makes a series of selections to identify his/her location. Each successive question/selection can further limit the physical area of the user's location. For example, the user can be prompted to identify the building (e.g., street address), a floor, a room number, a cubicle number, etc.

[0043] Continuing with step A3, once entered, the location information can be compared to existing area nodes H1-H7 in hierarchical representation 2 (FIG. 1). In step A4, user information U1-U5 (FIG. 1) is associated with the corresponding area node H1-H7 (FIG. 1) when the entered location information matches the location information for an area node H1-H7 in hierarchical representation 2. When the location information does not match any area node H1-H7, then in step A5, the user is asked to confirm the location information. If the user indicates that the location information is not valid, then processing can return to step A2 to obtain corrected location information. However, if the user indicates that the location information is correct, then in step A6, a new area node H1-H7 can be added to hierarchical representation 2. In particular, the location information can be analyzed to determine an appropriate location for the new area node H1-H7. For example, if area nodes H1-H7 exist for the specified building and floor, but not for the specified room number, then the new area node H1-H7 can be placed in hierarchical representation 2 beneath the existing floor node H2-H3. In step A4, user information U1-U5 can be associated with the new area node H1-H7.

[0044] Returning to FIG. 1, various interfaces can be provided to the user in an effort to ensure the integrity of the entered location information. For example, when designating a location, the user can be presented with a list of locations currently having area nodes H1-H7 within hierarchical representation 2 for each selection. The user can select the appropriate location from the list or choose to add a new location. In the latter case, the user can confirm that the entered location information is correct before a corresponding area node H1-H7 is added to hierarchical representation 2. For example, an occupant could initially enter his/her occupant information U3 and corresponding device information D1. Subsequently, the occupant can be prompted identify his/her office location. To this extent, the occupant could select an entry that corresponds to building node H1, and a floor that corresponds to floor node H2. However, hierarchical representation 2 may not already include a floor area node (e.g., floor area node H5) that corresponds to the user's office number for selection. In this case, the user can request to enter a new office number. A new floor area node H5 can be added to hierarchical representation 2 that corresponds to the new office number, and occupant information U3 can be associated with it. When a new area node H1-H7 is added to hierarchical representation 2, the user or a designated user can be requested to manually enter in additional location information such as directions to one or more locations(s) (e.g., stairs, elevator, bathroom, etc.), communication information for the area node H1-H7 (e.g., telephone extension, intercom, network address, etc.), and the like.

[0045] FIG. 1 also shows user nodes U4-U5 associated with hierarchical representation 2 that include user information for other users. User information U4-U5 can be associated with hierarchical representation 2 in a manner similar to occupant information U1-U3. However, user information U4-U5 can be associated with an area node H1-H7 based on a situation that may

occur within the corresponding area. To this extent, user information U4-U5 may correspond to occupants or non-occupants of the building. For example, as described further below with reference to an illustrative application, user information U4 can correspond to an emergency responder, and be associated with floor node H3. In this case, user information U4 can be used when an emergency event occurs on the floor corresponding to floor node H3. Similarly, user information U5 can correspond to a building manager and be used when a problem occurs with the building (e.g., a water leak or heating problem).

[0046] User information for each user can be stored in a user node U1-U5, or can be stored in a user node U1-U5 having one or more child nodes. In the latter case, each user node U1-U5 can include information personal to the user (e.g., his/her name), and each child node can include information about an item associated with the corresponding user. For example, user node U3 is shown having a device node D1 as a child node. Device node D1 can include device information that corresponds to a personal device that can be used to contact the corresponding user. Other information such as electronic mailing address(es), family member(s), etc., could be similarly stored in user node U1-U5 and/or one or more child nodes.

[0047] It is understood that while hierarchical representation 2 only shows user information U1-U5 for a single user associated with an area node H1-H7, user information U1-U5 for multiple users could be associated with an area node H1-H7. For example, floor area node H5 could correspond to a conference room, and user information U1-U5 could be associated with floor area node H5 for each occupant taking part in a meeting in the conference room. Further, a user could have his/her user information U1-U5 associated with multiple area nodes H1-H7 in hierarchical representation 2 based on his/her location and/or based on one or more situations in which the user is contacted. For example, user information U4 could correspond to an occupant

of floor H3. Similarly, in addition to user information U5, the building manager could have

his/her information associated with an area node H1-H7 that corresponds to his/her office

location. Information stored in area nodes H1-H7, user nodes U1-U5, and/or device node D1 can

vary based on the applications in which hierarchical representation 2 is used. Examples of

information that can be included will be discussed further below with reference to illustrative

applications.

[0048]   Numerous alternative hierarchical representations are possible. For example, FIG. 6

shows a hierarchical representation 102 that represents a geographic area such as a city. As

shown, hierarchical representation 102 could comprise several levels of area nodes G1-G11

comprising a city node G1, zip code nodes G2-G3, block nodes G4-G5, and building nodes G6-

G7. In this case, area information can be obtained from a city map 6 or the like, and area nodes

G1-G7 can be linked to city map 6. User information C1-C4 associated with area nodes G1-G7

could comprise mayor information C1 that is associated with city node G1, and responder

information C2 that is associated with a block node G5. Mayor information C1 and/or station

information C2 can comprise general contact information for an office (e.g., mayor's office, fire

station) that is associated with the corresponding geographic area. To this extent, an occupant

and/or other user can comprise a corporation or the like, rather than a particular individual.

Further, the occupant/user could comprise a hierarchical representation of the corporation or

other entity.

[0049]   Further, floor node G9 is shown associated with responder C3, which is also associated

with room node G11. Responder C3 could comprise an occupant of the corresponding floor

(e.g., in the room represented by room node G11) that is a designated foreman or the like. In this

case, responder C3 could be responsible for ensuring that occupants of floor G9 evacuate safely

when an emergency event occurs. Room node G10 is also shown having an associated schedule S. Schedule S could comprise, for example, a schedule of events (e.g., meetings, courses) that are scheduled to occur in room G10. Based on schedule S, users C1-C4 that are scheduled to take part in the event can be associated with room G10 during the event.

[0050] When hierarchical representation 102 comprises a larger geographic area such as a city, state, etc., some or all of user information C1-C4 and/or location information G1-G11 could be automatically obtained from a telephone directory, a 911 directory, a mailing list, a company directory, a government directory, etc. Further, in addition or alternative to zip code nodes G2-G3, hierarchical representation 102 could comprise a level having fire district nodes. This configuration could be used to readily distinguish which fire station should be contacted when an emergency event is detected. Still further, hierarchical representation 102 could comprise various hierarchical levels for a school district (e.g., school district nodes, school nodes for each school in the school district, and/or grade nodes for each grade in the school) that would enable parents to be contacted when an event occurs at a particular school district (e.g., vote for budget), a particular school (e.g., school closing early) and/or a particular grade (e.g., class trip canceled). When hierarchical representation 102 includes one or more school-based levels, user information C1-C4 can be obtained from student information provided to each school.

[0051] As noted above, user information C1-C4 can comprise information on one or more ways to contact the corresponding user. For example, contact information can include one or more of: a mailing address, a telephone number, an email address, and the like. When an event occurs and/or a communication is desired for one or more users, the contact information used to contact the corresponding user can be selected based on the reason that the user is being contacted. For example, if a user is being informed that he/she should evacuate a building, then

the telephone number(s) can be first used in an attempt to quickly contact the user. However, if the user is being informed of an upcoming social event, a paper mailing or email communication may be preferred.

II. OVERVIEW OF AN ILLUSTRATIVE SYSTEM

[0052] FIG. 3 shows an illustrative system 10 for managing occupants of a physical area (e.g., a building). In particular, computer 12 can obtain user information U1-U5 (FIG. 1) about an occupant 42 and/or other user such as an emergency responder 48, and store user information U1-U5 in, for example, storage unit 24. Further, user information U1-U5 can be associated with hierarchical representation 2 (FIG. 1) of the physical area that can also be stored in, for example, storage unit 24. Hierarchical representation 2 and associated user information U1-U5 can be used to provide information on the corresponding users (e.g., occupant 42 and/or responder 48) as discussed further below with reference to illustrative applications.

[0053] Users such as occupant 42 and/or responder 48 can access hierarchical representation 2 (FIG. 1) by using devices 44, 46 that communicate with computer 12 using a network 26. Further, devices 44, 46 can communicate with each other either directly over network 26 or using computer 12. To this extent, network 26 can comprise any type of communications link. For example, some or all of network 26 can comprise an addressable connection in a client-server (or server-server) environment that may utilize any combination of wireline and/or wireless transmission methods. In this instance, computer 12 and devices 44, 46 may utilize conventional network connectivity, such as Token Ring, Ethernet, WiFi or other conventional communications standards. Further, network 26 can comprise any type of network, including the Internet, a wide area network (WAN), a local area network (LAN), a virtual private network

(VPN), a wireless network, etc. Where computer 12 and/or devices 44, 46 communicate via the Internet, connectivity could be provided by conventional TCP/IP sockets-based protocol, and one or more of computer 12 and devices 44, 46 could utilize an Internet service provider to establish connectivity.

[0054] As shown, computer 12 generally includes a central processing unit (CPU) 14, a memory 16, an input/output (I/O) interface 18, a bus 20, external I/O devices/resources 22, and a storage unit 24. CPU 14 may comprise a single processing unit, or be distributed across one or more processing units in one or more locations, e.g., on a client and server. Memory 16 may comprise any known type of data storage and/or transmission media, including magnetic media, optical media, random access memory (RAM), read-only memory (ROM), a data cache, a data object, etc. Storage unit 24 may comprise any type of data storage for providing storage for information necessary to carry out the invention as described herein. As such, storage unit 24 may include one or more storage devices, such as a magnetic disk drive or an optical disk drive. Moreover, similar to CPU 14, memory 16 and/or storage unit 24 may reside at a single physical location, comprising one or more types of data storage, or be distributed across a plurality of physical systems in various forms. Further, memory 16 and/or storage unit 24 can include data distributed across, for example, a LAN, a WAN or a storage area network (SAN) (not shown).

[0055] I/O interface 18 may comprise any system for exchanging information to/from one or more external I/O devices 22. I/O devices 22 may comprise any known type of external device, including speakers, a CRT, LED screen, handheld device, keyboard, mouse, voice recognition system, speech output system, printer, monitor/display, facsimile, pager, communication hardware/software, etc. Bus 20 provides a communication link between each of the components

in computer 12 and likewise may comprise any known type of transmission link, including electrical, optical, wireless, etc.

[0056] It is understood that computer 12 is only an illustrative representation of a computing device. As a result, various combinations of components may be incorporated into computer 12. It is also understood that devices 44, 46 typically include the same elements as shown in computer 12 (e.g., CPU, memory, I/O interface, etc.). These have not been separately shown and discussed for brevity. Further, it is understood that each computer 12 and device 44, 46 comprises any type of computing device capable of communicating with one or more other computing devices, such as a server, a desktop computer, a laptop, a handheld device, a mobile phone, a pager, a personal digital assistant, etc. However, it is understood that if computer 12 or a device 44, 46 is a handheld device or the like, a display could be contained within computer 12 or device 44, 46, and not as an external I/O device 22 as shown and described in FIG. 3.

[0057] Computer 12 is shown including an occupant management system 28 that manages occupants of a physical area. Various systems included in occupant management system 28 can carry out the method steps shown in FIG. 2 and described above with reference to FIG. 1. For example, occupant management system 28 is shown including a plan system 30 that can obtain a plan of a physical area, such as building plan 4 (FIG. 1), as described with reference to step G1 (FIG. 2). Occupant management system 28 is also shown including a hierarchy system 32 that can generate a hierarchical representation of the physical area, such as hierarchical representation 2 (FIG. 1), as described with reference to step G2 (FIG. 2). Further, occupant management system 28 is shown including a user system 34 for obtaining user information such as user information U1-U5 (FIG. 1) and a corresponding area of the physical area as described in steps

G3-G4 (FIG. 2), and a merge system 36 for associating the user information with hierarchical representation 2 as described in step G5 (FIG. 2).

[0058]   As will be discussed further below, hierarchical representation 2 (FIG. 1) and associated user information U1-U5 (FIG. 1) can be used in various applications. For example, hierarchical representation 2 can be used to obtain directions from an occupant's location to another location within the physical area. To this extent, occupant management system 28 is shown including a directions system 38. Further, hierarchical representation 2 can be accessed to determine a location of one or more occupants. To this extent, occupant management system 28 is shown including a status system 40 for obtaining a status (e.g., location, health) of one or more occupants 42. It is understood that the various systems shown implemented as part of occupant management system 28 are only illustrative systems. As a result, additional or fewer systems could be implemented based on the desired functionality. Further, one or more systems could be combined and/or split into separate systems that provide the same functionality. Still further, it is understood that devices 44, 46 could also include one or more systems that provide functionality for the current invention.

III. APPLICATIONS

A. DIRECTIONS AND CONTACT INFORMATION

[0059]   Returning to FIG. 1, the information stored at each area node H1-H7, and in user nodes U1-U5 can vary based on the application in which hierarchical representation 2 is used. In one application, directions system 38 (FIG. 3) can use hierarchical representation 2 to provide custom directions for an occupant 42 (FIG. 3) to move from a particular starting location to a destination location. In this case, each area node H1-H7 can include information on the exit(s)

for the corresponding physical area, and can include directions from each exit for the area to each entry point for the area represented by its parent area node H1-H7. In this manner, directions can be efficiently combined using hierarchical representation 2 to generate directions from any starting location to any destination location.

[0060]   For example, occupant 42 (FIG. 3) may correspond to occupant information U2, and be located in the area represented by sub-area node H7. Further, occupant 42 may desire directions from his current location to an area on the floor corresponding to floor node H3. In this case, hierarchical representation 2 can be used to obtain directions from sub-area node H7 to an entry point for floor area node H4, and from the entry point for floor area node H4 to an entry point for floor node H2 (e.g., an elevator or a staircase). These directions can be combined with directions from a corresponding entry point for floor node H3 to the destination area located on the floor corresponding to floor node H3. Further, if occupant 42 desires to use a particular entry point/exit area (e.g., stairs), then the directions can be readily customized to use the particular entry point/exit area. As is readily apparent, numerous possible routes may be selected. To efficiently select a short route, the directions to each entry point can be sorted from shortest to longest. Further, information such as distance and direction (e.g., compass direction) can be included in the directions. Various algorithms can be used to provide an efficient set of directions and remove any backtracking that may be included in the originally generated directions.

[0061]   In generating directions for an occupant 42 (FIG. 3), directions system 38 (FIG. 3) can use the area node H1-H7 with which occupant 42 is associated as a default starting point. However, occupant 42 can be allowed to select any starting point. In selecting a destination point, a list of common destinations (e.g., bathroom, receptionist, building exit, conference room,

etc.) can be presented to occupant 42 for selection. Further, occupant 42 can select a destination point by selecting another occupant's name, entering an office number, selecting an area on building plan 4, etc. Still further, occupant 42 can browse area nodes H1-H7 and their corresponding areas to determine the name of an occupant 42 in a particular office or the like.

[0062]   To this extent, occupant information U1-U3 can include the name of the corresponding occupant 42 (FIG. 3). Contact information such as information for one or more handheld devices, mobile telephones, home telephones, email addresses, and/or pagers, a home address, etc., can also be included as occupant information U1-U3 and/or as one or more child nodes of occupant information U1-U3, such as device node D1. Further, occupant information U1-U3 and/or one or more child nodes could include a present/absent status indicating whether the corresponding occupant 42 is present within the building, logged into a network, etc. In this case, a user can determine which contact information may be successful in contacting the occupant 42. For example, when a status indicates that occupant 42 is currently available on a computer network, the user could attempt to contact occupant 42 using his/her email address.

[0063]   Similarly, user information U4-U5 and/or one or more child nodes that are associated with portions of the physical area can also include some or all of the contact information stored in occupant information U1-U3. User information U4-U5 can also include information that identifies the one or more situations in which the corresponding user should be contacted. In this manner, a user can select the appropriate user that should be contacted based on the current situation, and also efficiently obtain the contact information for the user.

[0064]   One or more area nodes H1-H7 could also include contact information for the corresponding area. Alternatively, this information could be included in one or more child nodes of an area node H1-H7 as shown with device node D1. For example, sub-area node H6 could

correspond to an office. As a result, telephone information such as an extension number for the office, computer information such as a network address for a network outlet located in the office, and the like can be stored in area node H6 or a child node. In this case, when a user seeks to contact occupant 42 (FIG. 3), contact information stored in both the occupant information U1-U3 for occupant 42, and the area node H1-H7 corresponding to the location of occupant 42 can be provided to the user. Other contact information can also be included in one or more area nodes H1-H7. For example, information on an intercom installed in an area could be associated with the corresponding area node H1-H7. When the user associated with user information U4-U5 is an occupant of the physical area, the contact information for the user's location can also be provided to a user. It is understood that when the user is not an occupant of the physical area, his/her personal contact information could include contact information for his/her location (e.g., office telephone number). As a result, various options for contacting a particular occupant or other individual related to a physical area can be readily stored and retrieved using hierarchical representation 2.

B. EMERGENCY RESPONSE

[0065] When an emergency event occurs, hierarchical representation 2 (FIG. 1) and/or occupant management system 28 (FIG. 3) can assist in communicating with and providing assistance to occupants 42 (FIG. 3). To this extent, it is understood that some or all of occupant management system 28 can be implemented and/or duplicated in a location that is away from the physical area (e.g., building) that is represented in hierarchical representation 2. This provides additional assurance that occupant management system 28 will continue to provide functionality during the emergency event. An emergency event may be automatically detected by occupant

management system 28 using a smoke detector, hazardous material detector, an earthquake sensor, a burglar alarm, or the like, and/or the occurrence of an emergency event (e.g., a heart attack) can be manually entered by an occupant 42 or another user. In any event, occupant management system 28 can assist in obtaining various information about occupants 42 and/or providing various information to occupants 42 and/or responders 48 (FIG. 3).

[0066] Hierarchical representation 2 (FIG. 1) can be used to obtain information on occupants 42 (FIG. 3) and/or establish two-way communication between occupant 42 and one or more emergency responders 48 (FIG. 3). For example, responder 48 may comprise a co-worker of occupant 42, and occupant 42 may require emergency assistance. In a typical office, co-workers generally communicate face-to-face, by telephone extension, and/or by email. However, should responder 48 be away from his/her office, each of these modes of communication may fail. Directions system 38 (FIG. 3) can obtain user information U4 (FIG. 1) for responder 48 using hierarchical representation 2, and can provide contact information for a mobile device 46 (FIG. 3) or the like for responder 48. As a result, communication between responder 48 and occupant 42 and/or other occupants 42 capable of providing assistance may be quickly commenced. Two-way communication between occupant 42 and a non-occupant responder 48 also can be established in the same manner.

[0067] Status system 40 (FIG. 3) can be used to obtain status information for one or more occupants 42 (FIG. 3) during an emergency event such as a fire that requires evacuation of a building. In particular, information about the location of occupant 42, whether occupant 42 is injured, whether occupant 42 is safe or evacuating, etc. can be obtained during an emergency event. To this extent, the directional information stored in area nodes H1-H7 (FIG. 1) and/or contact information stored in user information U1-U5 (FIG. 1) and the functionality provided by

directions system 38 (FIG. 3) can be used by status system 40. The status information can be

compiled and provided to one or more emergency responders 48 (FIG. 3). As a result, responder

48 can make more informed decisions about what action to take in responding to the emergency

event.

[0068]   FIG. 4 shows various method steps that can be carried out by status system 40 (FIG. 3)

for each occupant 42 (FIG. 3) of a building during an evacuation. In step E1, a status of

occupant 42 can be obtained. For example, directions system 38 (FIG. 3) can be used to obtain a

location and contact information for occupant 42. One of the various methods of contacting

occupant 42 can be selected, and a message can be sent using the selected method. The selected

method for contacting occupant 42 can be based on an anticipated robustness of the

communications medium, and/or the known or anticipated location of occupant 42. For

example, when occupant 42 has not previously logged onto a company network during the day,

an initially selected communications method could comprise a mobile telephone. The number

could be dialed and a recorded message could request that occupant 42 indicate his/her status.

Occupant 42 could select his/her status from a list of possibilities by speaking a number or

phrase, entering a number on the mobile telephone, or the like. In one embodiment, possible

selections comprise evacuating, safe, or unable to evacuate. If the selected communications

method fails to contact occupant 42, occupant 42 can be assigned an unknown status.

[0069]   In step E2, one of various alternatives are selected based on the status of occupant 42

(FIG. 3). When occupant 42 indicates that he/she is evacuating, processing flows to step E3, in

which a location of occupant 42 is obtained. The location can be obtained using any of a variety

of methods. For example, occupant 42 can enter his/her location manually or verbally using

device 44 (FIG. 3), the location can be automatically determined by determining the location of

device 44 (e.g., computer in an office or a wireless device using a particular wireless receiver), or the like.

[0070] After determining a location of occupant 42 (FIG. 3), in step E4, status system 40 (FIG. 3) and/or responder 48 (FIG. 3) can provide one or more instructions to occupant 42. For example, status system 40 can provide directions to the nearest exit and/or an alternative exit. Further, responder 48 can direct occupant 42 to a location at which he/she can receive assistance in evacuating the building. In either case, it is understood that directions system 38 (FIG. 3) can generate the directions that are provided to occupant 42 based on a starting point (e.g., current location of occupant 42) and a selected destination point (e.g., emergency exit).

[0071] In step E5, a summary of the status of all occupants 42 (FIG. 3) is updated. The summary can indicate the total number of occupants 42 currently in the building, the number of occupants 42 that have been contacted, the status of occupants 42, and/or the location of occupants 42. As discussed further below, the location and/or number of occupants 42 that require assistance can also be displayed. This information can be displayed on personal device 46 (FIG. 3) for responder 48 (FIG. 3), on device 46 located on a response vehicle, etc. As a result, responder 48 can make more informed decisions about the appropriate actions that should be taken.

[0072] After the summary is updated, flow returns to step E1, in which a status for occupant 42 is again obtained. In one embodiment, a status can be updated after a certain amount of time has passed (e.g., one minute) until occupant 42 indicates that he/she is safe. When occupant 42 (FIG. 3) indicates that he/she is safe, flow proceeds to step E6, in which the status summary is updated that occupant 42 is safe. At this point, no more communications are required for

occupant 42. However, a location could be obtained (e.g., street location) and/or occupant 42 can be directed to a particular safe location.

[0073] When status system 40 (FIG. 3) is unable to contact occupant 42 (FIG. 3), the status of occupant 42 can be set to unknown. In this case, flow can proceed to step E7, in which alternative contact information, if available, is used to again attempt to contact occupant 42. For example, status system 40 could first attempt to contact occupant 42 using his/her mobile device 44 (FIG. 3), and then select an office telephone for the probable location of occupant 42 if communications with mobile device 44 fail. To this extent, information such as whether occupant 42 was available on a computer network (e.g., logged in to work account) or not can be used to help determine a possible location of occupant 42 and thereby select an appropriate option to use in attempting to contact occupant 42. In any event, flow proceeds to step E5 in which the summary of occupants 42 is updated, and returns to step E1 in which status system 40 again attempts to obtain a status for occupant 42.

[0074] If occupant 42 (FIG. 3) indicates that he/she is unable to evacuate, flow proceeds to step E8. In step E8, a location of occupant 42 is obtained as discussed above with reference to step E3. In step E9, occupant 42 can provide a reason as to why he/she is unable to evacuate. For example, occupant 42 may have been injured, thereby requiring assistance. Alternatively, all exit routes may be unusable. In step E10, assistance can be directed for occupant 42 and/or instructions can be provided to occupant 42 based on the provided reason. For example, occupant 42 could be directed to a particular location and/or given instructions on treating his/her injury until assistance can arrive. To this extent, one or more responders 48 that may be available and/or nearby can be directed to the location of occupant 42 to provide assistance.

[0075] Information obtained for each occupant 42 (FIG. 3) can be incorporated into hierarchical representation 2 (FIG. 1) to adjust instructions and/or directions provided to other occupants 42. For example, occupant 42 may indicate that an exit is blocked. Consequently, hierarchical representation 2 can be updated to reflect that a particular exit is blocked, and directions for all other occupants 42 can avoid using that exit. Further, numerous occupants 42 may be directed to an exit (e.g., from a conference room). In this case, other occupants 42 may be directed to alternative exits to avoid crowding at a particular exit. Similarly, an occupant 42 that is also a responder 48 (FIG. 3) can be directed to a location of another occupant 42 that requires assistance.

[0076] Still further, hierarchical representation 2 (FIG. 1) can include various other information on the building that can be used during an emergency event. For example, hierarchical representation 2 can include location information for emergency equipment such as a first aid kit, fire extinguisher, etc. Occupants 42 (FIG. 3) and/or responders 48 (FIG. 3) can be directed to this emergency equipment using hierarchical representation 2. Other building information such as the locations of windows can also be included. In this case, when occupant 42 indicates that no exit routes are available, directions system 38 (FIG. 3) can direct occupant 42 to a window or the like where a responder 48 may be able to evacuate occupant 42. Other building information such as the location of windows, water pipes, heating/cooling ducts, electrical wiring, network wiring, etc. can be included in hierarchical representation 2. This information can be used, for example, when occupants 42 are unable to be contacted using telephone and/or network connections to isolate where a problem is located.

[0077] During an emergency, data can quickly change, and additional events can occur. As a result, hierarchical representation 2 (FIG. 1) can include one or more directives that are preset

depending on the type of emergency event. A directive can comprise one or more preset communications that are sent to a given location and/or occupant 42 (FIG. 3). For example, a directive can be associated with each area node H1-H7 for a fire emergency, an earthquake, or the like. When a fire is detected, the corresponding directive for each area node H1-H7 can be sent to each device associated with area node H1-H7 and/or each device associated with occupants 42 located at the corresponding location. The directives can comprise, for example, an evacuation order, directions to an exit route, safety instructions, etc. To this extent, each directive could interrupt any other activity being performed using the device. For example, a user may lose the ability to continue working on a document on a personal computer until the directive is answered. Further, directives can be used to obtain the status information of occupant 42 as discussed above.

IV. PREDEFINED RESPONSE PLAN

[0078] As discussed previously, the invention can further comprise a solution for responding to an emergency event that affects the physical area. Specifically, under the present invention, a response plan can be planned for one or more types of emergency events (e.g., personal injury, fire, earthquake, etc.). The response plan can include one or more response operations that are each associated with a responder, occupant, and/or area for the physical area. Each response operation can be implemented when the emergency event is identified to improve the response to the emergency event.

[0079] The response plan can include standard evacuation directions, directives for pre-assigned duties for emergency responders, and the like. To this extent, the response plan can be defined and stored in, for example, storage system 24 (FIG. 3). FIG. 7 shows an illustrative data

relationship diagram that defines a response plan 52 for an emergency event 50. Emergency

event 50 can comprise a definition of a unique emergency event (e.g., fire, heart attack, accident,

etc.). In response to the identification of emergency event 50, response plan 52 can be triggered

automatically or manually. For example, various sensors (e.g., fire, carbon monoxide, etc.)

could detect one or more abnormalities within a physical area. The detected abnormality can

then be compared to each defined emergency event 50 to locate one or more matching

emergency events 50. Similarly, the occurrence of emergency event 50 could be input by a user,

such as when an individual has a heart attack. In any event, once it has been indicated that

emergency event 50 has occurred/is occurring, response plan 52 can be implemented.

[0080] Response plan 52 can include one or more response operations 54A-B. Each response

operation 54A-B can comprise a particular response to emergency event 50. In an emergency,

an appropriate response will vary based on a location and/or individual. To this extent, response

operations 54A-B can be associated with one or more nodes in hierarchical representation 102

(FIG. 6). For example, in the case of a fire in the building represented by building node G7

(FIG. 6), response operation 54A could comprise a response provided to emergency

responder/occupant C3 (FIG. 6) to determine if the fire can be put out, while response operation

54B could comprise a response provided to occupants of building node G7 to evacuate the

building. Additional data 56 can be provided to adjust one or more parameters of response plan

52. For example, emergency event 50 could comprise a chemical spill. In this case, additional

data 56 can comprise data on weather, heating/cooling systems in a building, information on the

particular chemical, etc., and can be used to route the evacuation of individuals upwind of the

spill, anticipate how the spill will spread, turn on/off various systems to obtain a desired air flow

in a building, provide information to responders on appropriate protection/likely injuries, etc.

[0081] Each response operation 54A can include one or more response directives 58. A response directive 58 comprises information that is sent to a user. Response directive 58 can comprise instructions given to the user (e.g., evacuate using..., occupants unable to evacuate on floor...) and/or a request for data (e.g., evacuation status). Additional response directives 58 can be sent to the user once a previous directive is acknowledged, responded to, and/or after a predetermined amount of time has elapsed. Each response directive 58 includes one or more response instructions 60. Each response instruction 60 comprises the actual data that is sent for the corresponding response directive 58. For example, a response directive 60 could comprise an instruction to evacuate the building. An appropriate response instruction 60 can be selected based on the device that will be used to send response directive. For example, if the device is an intercom, a response instruction 60 that comprises an audio file can be selected. Alternatively, if the device is a personal computer, a response instruction 60 that includes a visual indication of the evacuation route can be provided. Still further, for a mobile device, a short text message can be provided.

[0082] Response operations 54A-B, response directives 58, and/or response instructions 60 can be modified based on additional data 56. For example, response operation 54B can comprise predefined instructions for evacuating the area. However, additional data 56 could comprise information that one or more exit routes are unsafe. As a result, response operation 54B could be modified so that occupants are diverted from the unsafe exit. It is understood that multiple emergency events 50 can share one or more response plans 52. Similarly, multiple response plans 52 can share one or more response operations 54A-B. For example, evacuation response operation 54B could be shared by both fire and chemical spill response plans 52.

[0083] Response plan 52 can be implemented in a tiered manner. In particular, one or more response operations 54A-B may be implemented based on a result from a previous response operation 54A-B, in a certain subset of actual instances of emergency event 50 (e.g., occupant unable to evacuate), may only be implemented if a responder indicates that it is necessary (e.g., confirmation of break-in), and/or may be implemented based on particular additional data 56 (e.g., earthquake of certain magnitude). For example, FIG. 8 shows an illustrative method of responding to a chemical spill that occurs, for example, in the building represented by building node G7 (FIG. 6). In step R1, a chemical spill is identified, triggering response plan 52 (FIG. 7). Initially, in step R2, a response operation 54 (FIG. 7) is implemented that contacts responder C3 (FIG. 6) for his/her evaluation of the severity of the chemical spill. In particular, responder C3 can determine what is the appropriate action that should be taken and designate the action to occupant management system 28 (FIG. 3).

[0084] In step R3, occupant management system 28 (FIG. 3) waits to obtain manual feedback from responder C3 (FIG. 6) as to the appropriate action. For example, responder C3 could indicate that no action is required (e.g., a false alarm, small spill, etc.), and the response plan 52 (FIG. 7) will terminate. Alternatively, responder C3 could indicate that the spill can be contained. In this case, processing can continue to step R4, in which a containment response operation 54 (FIG. 7) is implemented. Containment response operation 54 could comprise contacting the fire department (e.g., station C2 in FIG. 6), other responders within the building, and/or partially evacuating the building. Still further, responder C3 could indicate that a physical area (e.g., block G4 in FIG. 6) should be evacuated. In this case, processing can continue to step R5, in which an evacuation response operation 54 is implemented. In an evacuation response operation 54, mayor C1 (FIG. 6) could be notified, along with several fire departments, police

departments, hospitals, etc. Additionally, occupants C1-C4 (FIG. 6) could be provided

directions to evacuate upwind of the spill, and/or to use alternative routes in an effort to decrease

the amount of traffic on any one street.

[0085] Response plan 52 (FIG. 7) can also automatically implement tiered response operations

54A-B (FIG. 7). For example, if attempts to contact responder C3 (FIG. 6) in step R2 fail after a

predefined amount of time (e.g., time out), processing can automatically continue to step R5 to

implement an evacuation response operation 54. Similarly, if in step R1, an additional sensor

detects the chemical spill indicating that it has spread beyond containment (e.g., additional data

56 in FIG. 7 changes), processing can automatically continue to step R5.

V. SAMPLE USER INTERFACES

[0086] FIGS. 9A-I show illustrative user interfaces that can be displayed on device 44 (FIG. 3)

to occupant 42 (FIG. 3). In general, device 44 can comprise a mobile telephone or the like that

includes a display screen for displaying menus and the like. Further, device 44 can have

program code loaded therein that comprises, for example, JAVA™ program code that provides

support for interacting with occupant management system 28 (FIG. 3) using device 44. For

example, as shown in FIG. 9A, device 44 can comprise a handheld device that displays an

additional menu item 70 on a main menu 68. It is understood that various alternatives to menu

item 70 are possible. For example, on a personal computer, one or more processes can execute

continually execute in the background and/or have a link on a task bar to allow the device to

communicate with occupant management system 28.

[0087] Menu item 70 can allow occupant 42 to interact with occupant management system 28.

Once user selects menu item 70, an occupant management menu 72 can be displayed. Occupant

management menu 72 allows occupant 42 (FIG. 3) to manage his/her data. In particular, occupant 42 can choose to display/edit a user profile (e.g., name, home address, home phone, etc.), a location profile (e.g., office location), a contact profile (e.g., emergency contact individual/information), and a health profile (e.g., disabilities, allergies, etc.). The data can be displayed and/or modified to occupant 42 in any known manner. Further, occupant 42 can select information menu item 74 to obtain information from occupant management system 28. For example, occupant 42 could obtain directions from one location to another, determine where another individual is located, review an emergency exit route, etc.

[0088] After an emergency event is detected, device 44 (FIG. 3) can display a message to occupant 42 (FIG. 3) informing occupant 42 of the emergency event and requesting that he/she acknowledge the message. For example, FIG. 9C shows an illustrative message 76 that informs occupant 42 to evacuate a building. As shown, message 76 can be given a higher priority than any other displayed data/operations that can occur on device 44. To this extent, occupant 42 can be prevented from continuing to use device 44 for any other purpose until message 76 is acknowledged and/or occupant 42 indicates that he/she is safe. Further, a response operation 54A-54B (FIG. 7) could provide additional information/directions to occupant 42. For example, FIG. 9D shows an illustrative evacuation menu 78 that can be presented to occupant 42 after he/she acknowledges message 76 (FIG. 9C). Evacuation menu 78 allows occupant 42 to indicate his/her evacuation status. For example, occupant 42 can indicate that he/she has evacuated and is safe, has evacuated but needs medical assistance, is currently evacuating, is evacuating and needs assistance, or is unable to evacuate.

[0089] As shown in FIG. 9C, message 76 can include directions that occupant 42 (FIG. 3) should follow to exit the building. The directions can comprise part of response operation 54B

(FIG. 7), and can be associated with the location of occupant 42 (e.g., sub-area H7 in FIG. 1). In this manner, the directions can be quickly provided to occupant 42 without using substantial processing resources. However, additional data 56 (FIG. 7) may indicate that all or a portion of a predefined evacuation route is unsafe to use (e.g., blocked or overcrowded). In this case, response operation 54B can dynamically generate an alternative evacuation route using, for example, hierarchical representation 2 (FIG. 1) as discussed above. Alternatively, a responder U4 (FIG. 1) may provide alternative directions to occupant 42 so that responder U4 can provide assistance. In any event, FIG. 9E shows an illustrative message 80 that can be displayed to occupant 42 that designates an alternate exit route.

[0090] In addition to providing an evacuation status, occupant 42 (FIG. 3) could be requested to provide his/her location. To this extent, FIG. 9F shows an illustrative menu 82 that allows occupant 42 to quickly provide his/her location. In particular, occupant 42 can select a predefined location or send a message (e.g., text, audio, etc.) for his/her location. As shown in FIG. 9G, when occupant 42 indicates that he/she requires assistance, a menu 84 can be displayed that allows occupant 42 to select a predefined reason that assistance is required and/or send a message explaining why assistance is required. Similarly, when occupant 42 indicates that he/she is unable to evacuate, a menu 86 shown in FIG. 9H can be displayed to allow occupant 42 to indicate why he/she cannot evacuate.

[0091] As shown in FIGS. 9D-G, occupant 42 (FIG. 3) can also indicate when additional occupants are located with occupant 42. In this case, occupant 42 can designate how many others are with him/her. Additionally, FIG. 9I shows an illustrative screen 88 that can be presented to allow occupant 42 to identify one or more of the other occupants. For example, occupant 42 can enter in the other occupant's name, select from a list of other known occupants,

identify the occupant by an alternative unique identifier (e.g., telephone number, employee identifier, email address), etc. If one or more of the other occupants are visitors, and are not known by occupant management system 28 (FIG. 3), then additional information such as a telephone number and emergency contact information for the other occupant could be provided. For each additional occupant, occupant 42 could also designate whether he/she requires assistance as shown in FIG. 9G.

[0092] FIGS. 10A-C show illustrative user interfaces that can be displayed on device 46 (FIG. 3) to responder 48 (FIG. 3). In particular, FIG. 10A shows an illustrative menu 90 that can be displayed to responder 48 after an emergency event has been identified. As shown, responder 48 can select to view/edit information on the response plan, data on the emergency event itself (e.g., fire alarms that have been activated), a summary of the statuses for various occupants, locations of the responders, and/or choose to send a message to another responder and/or an occupant. Selection of any of the various choices can allow responder 48 to view data on the chosen item. For example, FIG. 10B shows a menu 92 that summarized the statuses of various occupants 42 (FIG. 3). In particular, menu 92 shows the number of occupants 42 that have not responded, have evacuated successfully, are currently evacuating, cannot evacuate, and/or require medical assistance. Based on this information responder 48 can make a more informed decision on how to respond to the emergency event. For example, as long as all occupants 42 are safely evacuating and/or have been evacuated, then there would be no need to send one or more responders 48 into danger searching for other occupants.

[0093] However, when one or more occupants 42 (FIG. 3) are unaccounted for, then responder 48 (FIG. 3) must determine an appropriate course of action. To further assist in this determination, responder 48 can obtain data on each occupant 42. For example, FIG. 10C shows

an illustrative screen 94 that includes data on an occupant that has not responded. In this case, screen 94 can display an office location as well as the general hours that the occupant is at the office. Responder 48 can use this information to determine a likelihood that occupant 42 has been harmed, a risk of sending another responder 48 to determine a location of occupant 42, etc. For example, in this case, screen 94 indicates that the occupant was scheduled to be on vacation. Screen 94 also allows responder 48 to view additional data on occupant 42, route assistance to the location of occupant 42, view a map of the physical area, etc.

[0094] The illustrative screens shown in FIGS. 9A-I and FIGS. 10A-C along with occupant management system 28 (FIG. 3) can assist in readily establishing communications between occupant(s) 42 (FIG. 3) and responder(s) 48 (FIG. 3). For example, occupant 42 can communicate with a default responder 48 based on his/her location (e.g., floor, room, building, etc.). For example, as shown in FIG. 6, occupant C4 can be placed in communication with responder C3 since occupant C4 is located on floor G9. As a result, occupant C4 will not be required to select the appropriate responder 48 with which to communicate. To this extent, when occupant C4 provides his/her status using menu 78 (FIG. 9D), for example, the status can be communicated to a device for responder C3. Once received, responder C3 could be allowed to select the received data (e.g., occupant's name) to initiate verbal communications with occupant C4 (e.g., using a mobile telephone), respond with a text message, etc. Additionally, status information sent by occupant 42 could be sent to multiple responders 48, a central call center such as a 911 operator or the like, a web site, or the like for displaying to additional users.

[0095] It is understood that the various screens shown in FIGS. 9A-I, and FIGS. 10A-C are only illustrative. To this extent, additional screens and/or menus can be incorporated as part of the invention, and alternative or additional functions can be provided to responder 48 (FIG. 3)

and/or occupant 42 (FIG. 3). Additionally, the illustrative screens are configured to fit on a small display space such as provided by a handheld device or the like. Alternatively, when additional display space is available (e.g., on a personal computer), a larger menu could be provided, graphics (e.g., a map) could be included, etc. Still further, for audio-only devices such as a mobile telephone, a series of prompts could be given that allow the user to respond orally.

VI. ALTERNATIVES

[0096] As noted previously, the invention can be implemented on a small scale, e.g., a house, or a large scale, e.g., a city or larger. In the former case, fire fighters responding to a house fire could be readily informed of the layout of a particular house, such as the location of a child's bedroom, potential sources of fire, etc. When used on a large scale, access to information can be limited based on the hierarchical representation 2 (FIG. 1). For example, an employee occupant 42 (FIG. 3) may only be able to view user information U1-U5 (FIG. 1) for co-workers. Further, the amount of user information (FIG. 1) that can be viewed may be limited by the identification of an occupant 42 as is known in the art. When multiple buildings are included in hierarchical representation 2, additional information such as directions to/from various locations (e.g., restaurants, shops, etc.) in the area can be available. To this extent, when a large scale emergency occurs that requires the evacuation of several buildings, occupants 42 can be given directions to alternative exit routes in the hope that traffic problems and the like can be lessened.

[0097] The invention can be used to develop an architectural design for a building and/or to approve the architectural design for construction. In particular, the invention can be used to automatically generate exit routes for various areas within the building and determine, for example, if one or more exit routes will suffer from overcrowding, one or more areas are not

sufficiently close to an exit route, etc. Based on feedback from the invention, adjustments to the architectural design can be made and simulated, thereby providing a cost efficient solution to ensure that a new building conforms to the required governmental standards, and/or provides a safe environment for its occupants. Further, an insurance actuarial or the like could determine a discount on the cost of insuring a building or the like that incorporates the invention. Additionally, the invention could be used to simulate exit routes and the like of an existing building or the like, and calculate an appropriate premium/discount based on the simulation results.

[0098] Additional user information U1-U5 (FIG. 1) can be incorporated into hierarchical representation 2 (FIG. 1) to provide further functionality for one or more applications. For example, personal information such as family contact information, health information (e.g., allergy, disability), and the like can be included. Further, information such as scheduled meetings, out of office plans, and the like can be included as and/or associated with user information U1-U5, and used to assist in locating an occupant 42 (FIG. 3) and/or responder 48 (FIG. 3) that may not respond to directives and/or queries as discussed above.

[0099] It is understood that the present invention can be realized in hardware, software, or a combination of hardware and software. Any kind of computer/server system(s) - or other apparatus adapted for carrying out the methods described herein - is suited. A typical combination of hardware and software could be a general-purpose computer system with a computer program that, when loaded and executed, carries out the respective methods described herein. Alternatively, a specific use computer (e.g., a finite state machine), containing specialized hardware for carrying out one or more of the functional tasks of the invention, could be utilized. The present invention can also be embedded in a computer program product, which

comprises all the respective features enabling the implementation of the methods described herein, and which - when loaded in a computer system - is able to carry out these methods. Computer program, software program, program, or software, in the present context mean any expression, in any language, code or notation, of a set of instructions intended to cause a system having an information processing capability to perform a particular function either directly or after either or both of the following: (a) conversion to another language, code or notation; and/or (b) reproduction in a different material form.

[0100]   The foregoing description of various embodiments of the invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed, and obviously, many modifications and variations are possible. Such modifications and variations that may be apparent to a person skilled in the art are intended to be included within the scope of the invention as defined by the accompanying claims.